

THE CLAIMS DEFINING THE INVENTION

1. A process for the removal and causticisation of sodium oxalate and/or sodium sulphate from a Bayer process liquor containing sodium carbonate and one or both  
5 of sodium oxalate and sodium sulphate in an alumina refinery, the process comprising the steps of:

removing aluminate ions from the Bayer liquor through the formation of a carbonate-bearing hydrocalumite and/or sulphate-bearing hydrocalumite; and,  
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treating the liquor with sufficient lime to remove and causticise any residual carbonate ions and some or all of the oxalate ions present whereby any reacted lime solids thus formed can be separated and safely disposed of.

- 15 2. A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 1, wherein the process comprises a further step, prior to said step of removing aluminate ions, in which the liquor is enriched with sulphate and/or oxalate such that any aluminate and/or carbonate ions entering with the sulphate and/or oxalate are also removed.

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3. A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 1, wherein the process comprises a further step, following said step of removing aluminate ions, of separating the carbonate-bearing hydrocalumite species and/or sulphate-bearing hydrocalumite species from the  
25 Bayer liquor to form a clarified liquor.

4. A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 3, wherein the process comprises the further step of re-  
30 using said hydrocalumite species in an external causticisation process, whereby the aluminate contained within the hydrocalumite species is recovered.

5. A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 1, wherein the process further comprises a pre-

causticisation step in which the Bayer liquor is first causticised to reduce the concentration of carbonate ions, prior to said step of removing aluminate ions.

6. A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 5, wherein said pre-causticisation step includes heating the liquor to close to boiling point, adding sufficient lime to react with the carbonate ions to produce substantially calcium carbonate and separating the reacted lime solids from the liquor.
7. A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 6, wherein the heated liquor is enriched with sulphate and/or oxalate prior to pre-causticisation to ensure that any carbonate ions entering with the sulphate and/or oxalate are also causticised.
8. A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 1, wherein the S concentration of the Bayer process liquor prior to the said step of removing aluminate ions is between 0 and 250g/l, and the liquor is maintained at a temperature of between 20°C and 90°C, with a reaction time of up to 120 minutes.
9. A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 8, wherein the S concentration of the Bayer process liquor prior to the said step of removing aluminate ions is less than 150 g/l, and the liquor is maintained at a temperature of between 50°C and 70°C, with a reaction time of approximately 30 minutes.
10. A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 9, wherein said step of treating the clarified liquor with sufficient lime is conducted at a temperature between 20°C and 140°C, with a reaction time of between 0.25 to 4.0 hours.
11. A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 10, wherein said step of treating the clarified liquor with

sufficient lime is conducted at a temperature between 50°C and 80°C, with a reaction time of between 0.5 to 1.0 hours.

12. A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 11, wherein the said step of treating the liquor with sufficient lime is followed by a step of separating the reacted lime solids from the liquor and disposing of the solids or washing and drying the solids for calcination and re-use.
13. A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 7, wherein the S concentration of the Bayer process liquor prior to said pre-causticisation step is between 0 and 250 g/l, and during said pre-causticisation step the liquor is heated to approximately 100°C.
14. A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 13, wherein the clarified liquor is cooled to between 30°C and 90°C prior to said step of removing the aluminate ions.
15. An apparatus for the removal and causticisation of sodium oxalate and/or sodium sulphate from a Bayer process liquor containing sodium carbonate and one or both of sodium oxalate and sodium sulphate in an alumina refinery, the apparatus comprising:
- means for removing aluminate ions from the Bayer liquor through the formation of a carbonate-bearing hydrocalumite and/or sulphate-bearing hydrocalumite; and,
- means for treating the liquor with sufficient lime to remove and causticise any residual carbonate ions and some or all of the oxalate ions present whereby any reacted lime solids thus formed can be separated and safely disposed of.
16. An apparatus for removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 15, wherein said means for removing aluminate ions comprises a first reaction vessel to which sufficient lime is added to react with all of

the aluminate ions in the liquor.

17. An apparatus for removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 16, wherein the apparatus further comprises a means  
5 for separating the carbonate-bearing hydrocalumite and/or sulphate-bearing hydrocalumite from the liquor to form a clarified liquor.
18. An apparatus for removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 17, wherein the means for treating the liquor comprises  
10 a second reaction vessel to which sufficient lime is added to react with the sodium oxalate in the clarified liquor to form calcium oxalate and with any remaining carbonate ions to form sodium carbonate.
19. An apparatus for removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 15, wherein said means for removing aluminate ions  
15 and said means for treating the liquor are comprised in a single reaction vessel to which sufficient lime is added to react with the aluminate ions to form said carbonate-bearing and/or sulphate-bearing hydrocalumite, together with sufficient additional lime to react with the sodium oxalate to form calcium oxalate.  
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20. An apparatus for removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 19, wherein another first reaction vessel is provided for  
treating the liquor, prior to entry into said single reaction vessel, with sufficient lime  
to react with the sodium carbonate and then discharged to a solid/liquid separation  
25 device for separating any solids, which will consist primarily of calcium carbonate, to form a clarified liquor.